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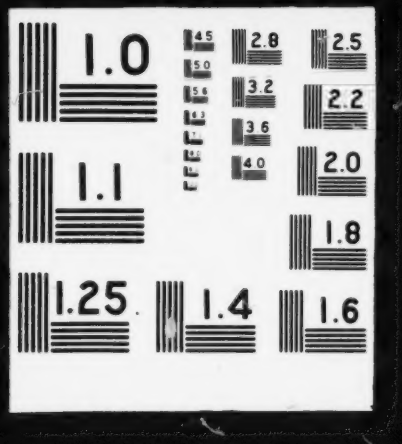

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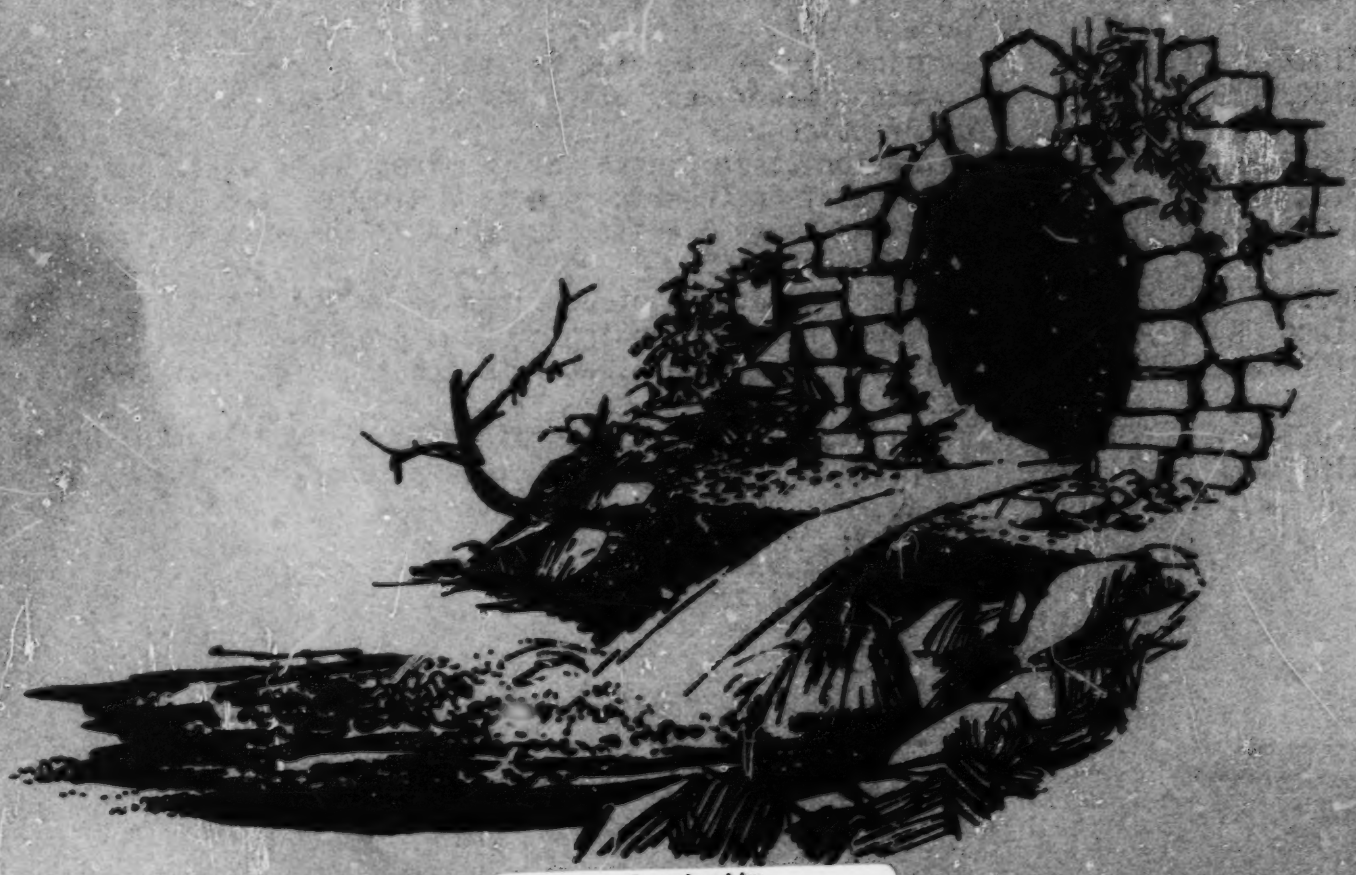

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*Combined sewers, *Storm sewers,

27 Abstract

The second quarterly supplement to SELECTED URBAN STORM WATER RUNOFF ABSTRACTS is a compilation of abstracts summarizing articles from a variety of technical literature concerning the problem of urban drainage published from October 1970 through December 1970. The 50 abstracts covering a range of ten sections are arranged alphabetically by author and numerically by abstract number within each category. Each item includes a bibliographic citation, an abstract, and a set of indexing descriptors and identifiers. A cumulative subject index at the end of the volume provides the necessary access to individual concepts. An author index and a journal list are also included. (Ortner - Franklin Institute)
~~This work was submitted in fulfillment of Contract 14-12-904 between the Water Quality Office of the Environmental Protection Agency and the Franklin Institute Research Laboratories.~~ (See also W69-10085, W71-062 , and W71-0 , this abstract)

Abstractor Dorothy A. Ortner

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SELECTED URBAN STORM WATER RUNOFF ABSTRACTS

Second Quarterly Issue

by

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The Franklin Institute Research Laboratories

Prepared for the

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January 1971

EPA Review Notice

This report has been reviewed by the Water Quality Office and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

ABSTRACT

The second quarterly supplement to SELECTED URBAN STORM WATER RUNOFF ABSTRACTS is a compilation of abstracts summarizing articles from a variety of technical literature concerning the problem of urban drainage published from October 1970 through December 1970. The 50 abstracts covering a range of ten sections are arranged alphabetically by author and numerically by abstract number within each category. Each item includes a bibliographic citation, an abstract, and a set of indexing descriptors and identifiers. A cumulative subject index at the end of the volume provides the necessary access to individual concepts. An author index and a journal list are also included.

This work was submitted in fulfillment of Contract 14-12-904 between the Water Quality Office of the Environmental Protection Agency and the Franklin Institute Research Laboratories.

Key Words: Combined sewers, overflow, pollution abatement, sewerage, sewers, storm runoff, urbanization, water pollution sources, treatment facilities, water pollution control.

FOREWORD

The second quarterly supplement to SELECTED URBAN STORM WATER RUNOFF ABSTRACTS is a compilation of abstracts summarizing articles from a variety of technical publications covering subjects pertinent to the problem of urban drainage. There was no reported material solely related to the storm sewer sub-section.

The present work includes 50 abstracts of documents published for the most part from October 1970 through December 1970. For convenience, the abstracts are classed in ten categories and arranged alphabetically by author and numerically by abstract number within each category. Since most of the papers fit into more than one category, a cumulative subject index at the end of the volume provides the necessary access to individual concepts and should be utilized for locating all abstracts in which this concept is significant. The numbers following an index term are the numbers for the abstracts in which this term is found. Each item includes a bibliographic citation, an abstract, and a set of indexing descriptors (subject terms listed in the WATER RESOURCES THESAURUS' November 1966 edition) and identifiers (newly suggested index terms). The most important index terms are marked by an asterisk. An author index and a journal list are included for the reader's benefit.

Copies of the articles abstracted in most cases can be obtained from research libraries covering water pollution or public health engineering literature.

Suggestions concerning the improvement of content and format, or expansion of subject coverage in future supplements will be gratefully received.

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SECTION 1.

Construction: Equipment and Materials; and Instrumentation

037
PRIME NEED: INSTRUMENTS FOR USE IN FIELD,

Rene J. Bender
Power, Vol 114, No 10, pp 50-53, Oct 1970.

Descriptors: *Water pollution control, *Instrumentation, *Monitoring, *Administration, Methodology.

As demand for pollution control has increased, so has the need for adequate instrumentation. Control of water pollution has reached a standard clearly ahead of air pollution control, and resolves itself into a matter of cost. Water management is becoming increasingly popular; monitoring instruments include pH meters, turbidity indicators, dissolved-solids recorders, DO, BOD, and COD meters, oxidation-reduction-potential sensors, and chloride-ion analyzers. The article contains recent developments in the following areas of methodology and instrumentation: the carbonaceous analyzer, atomic absorption, sewage treatment monitors, telemetry, and flow meters.

038
A GROWING MARKET FOR WATER AND WASTEWATER TREATMENT EQUIPMENT,

K. L. Kollar and William G. Youngwirth
Water Sewage Works, Vol 117, No 9, pp 319-325, Sep 1970. 7 tab, 2 chart, 8 ref.

Descriptors: *Treatment facilities, *Equipment, *Analysis, Evaluation, Construction equipment, Surveys.

This report summarizes and compares two studies (1965 and 1968) which are based on the response of manufacturers to a questionnaire on manufacturing plant production capacity and value of shipments of equipment used only in water and wastewater treatment plants. Both surveys accounted for about 95% and 70% of equipment sales to municipal water and wastewater treatment utilities and industrial water and wastewater treatment respectively. In 1968, $248.4 million was spent for water and wastewater treatment equipment by municipalities and industry with a 64+% increase in pollution control equipment. Tabled information includes: total expenditures, equipment shipments, structures, production capacities, and GNP comparisons. A list of equipment definitions is given.

039
PHOTOGRAPHY AND OTHER REMOTE SENSING OF WATER POLLUTION,

R. K. Lane
Water Pollution Control, Vol 108, No 9, pp 20-21, Sep 1970.

Descriptors: *Photography, *Data collections, *Remote sensing, Effluents, Pollutants.
Identifiers: Water pollution studies.

Photography has long been used as a remote sensing tool for environmental data collection from aircraft. In water pollution studies most interest is centered around the need for observing the behavior of effluents which introduce pollutants to rivers or lakes. Qualitative examinations of effluents through photography can be useful to locate effluents, to determine how their behavior is affected by local characteristics, ambient flow rates, and meteorological conditions, and to determine relative intensities of discharges. Techniques for quantitative assessments of polluted discharges are not yet operationally effective.

040
PRECAST, REINFORCED CONCRETE MEMBERS IN THE CONSTRUCTION OF WATER SUPPLY AND SEWERAGE SYSTEMS.

V. I. Lerner and I. S. Chumakov
Beton i Zhelezobeton, No 2, pp 8-10, Feb 1970.

Descriptors: *Construction materials, *Concrete construction, Sewerage.
Identifiers: *Water supply systems, *Sewerage systems, *USSR.

The construction of sewers and water supply tunnels made of large dimensional and relatively thin-walled reinforced concrete components has been experimented with by the Soviets. The methods of construction of reinforced concrete waterproof wall panels for rectangular and round vessels are discussed.

041
DEVELOPMENT AND PERFORMANCE OF A MOBILE WATER QUALITY MONITOR,

Raymond W. Raible and M. K. Testerman
Advan Instr, Vol 24, Part 3, 1969. 3 fig, 6 ref, 5 p.
Presented at the Instrument Society of America 24th Annual Conference, Oct 27-30, 1969.

Descriptors: *Instrumentation, *Control systems, *Monitoring.
Identifiers: *Data acquisitions.

A mobile water quality monitor intended for extended unattended use in locations where power lines are not available and for survey use is described. All solid state electronics are employed. Field tests have been performed for the past 2½ years. Conclusions and problems concerning the monitors and transducers will be reviewed. Suggestions for future development are given.

SECTION 2.

Overflows and Regulation Devices

042
PRIMARY WATER TREATMENT AIDED BY COMPACT SEPARATOR,
Sweco, Inc.

Chem Eng, Vol 77, No 15, pp 48,50, Jul 13, 1970. 1 fig.

Descriptors: *Sewage treatment, *Waste water treatment, *Sewage, *Storm runoff, Pollution abatement.
Identifiers: *Wastewater concentrator.

A new kind of primary wastewater treatment has been introduced to help pollution abatement specialists solve two of their most recurrent headaches: inadequate acreage for large enough settling basins, and excessive wastewater loads resulting from heavy rainfalls. The wastewater concentrator, as this unit is called, was designed primarily for municipal sewage treatment.

043
FINE-MESH MECHANICAL SCREEN CONCENTRATES PEAK WASTE LOADS,

Filtration Eng, Vol 1, No 10, pp 8-10, Jun 1970. 2 fig.

Descriptors: *Wastewater treatment, *Pollution abatement, *Overflow, *Sewers, Storm runoff, Equipment.
Identifiers: *Wastewater concentrator.

A new product known as the wastewater concentrator uses a mechanical screening principle to reduce pollution caused by the overflow from combined storm and sanitary sewage systems during periods of heavy rainfall. In storm overflow service, the concentrator can augment a treatment process via high-rate, fine mesh centrifugal screening which relieves the existing system of its hydraulic overload. It was demonstrated that the concentrator is capable of removing 99 percent of the floatable and settleable solids, 34 percent of the suspended solids, and 27 percent of the COD from sanitary waste. A description of the operation, apparatus, and maintenance involved in the concentrator's performance is given.

044
MICROSTRAINING AND DISINFECTION OF COMBINED SEWER OVERFLOWS,
Cochrane Division, Crane Company, King of Prussia, Pennsylvania

FWQA Contract No 14-12-136, Program No 11023EVO, Jun 1970. 76 p, 16 fig, 7 tab, 12 ref.

Descriptors: *Sewers, *Storm runoff, *Filtration, *Water pollution control, *Cost comparisons, Water quality, Ozone, Chlorine, Biochemical oxygen demand.
Identifiers: *Microstraining, *Combined sewer overflow, *Suspended solids removal.

A microstrainer screen of a nominal aperture of 23 microns was used to remove up to 98% of the suspended solids from a combined sewer overflow. The sewer in a residential area of Philadelphia has an average dwf of 1,000 gph. The maximum combined sewer flow during rainstorms in one year of operation was 304,000 gph. Volatile suspended solids removals with the above screen have averaged 68% and 71% during different test periods. Results indicated that there was a slightly better kill of coliform group bacteria with chlorine than with ozone in the microstrainer effluents when both were used at an initial nominal concentration of 5 ppm, with 5 to 12 minutes detention time. Chlorine was applied at slightly higher levels and with better control than ozone. Preliminary estimates of the costs of treatment via this process, using tentatively-established throughput rates, show that the capital costs per acre of drainage would be approximately $10,200 for microstraining alone, $11,200 for microstraining plus chlorination, and $19,800 for microstraining plus ozonation. Of eight other currently-proposed schemes, whose costs were estimated, only surface impoundment appears competitive.

045
ROTARY VIBRATORY FINE SCREENING OF COMBINED SEWER OVERFLOWS; Primary Treatment of Storm Water Overflow from Combined Sewers by High-Rate, Fine-Mesh Screens,
Cornell, Howland, Hayes and Merryfield Consulting Engineers and Planners

Federal Water Pollution Control Admin., Publication No DAST-5, Mar 1970. 6 tab, 18 fig, 3 append, 4 modifications.

Descriptors: *Investigations, *Screens, Overflow, Separation techniques, Waste water treatment.
Identifiers: *Storm overflows, *Rotary screens, Treatment method, Combined sewers.

The objective of this study was to determine the feasibility, effectiveness, and economics of employing high-rate, fine-mesh screening for primary treatment of storm water overflow from combined sewer systems. The final form of the screening unit stands 63 inches high and has an outside diameter of 80 inches. The unit is fed by an 8-inch pipe carrying 1700 gpm which is distributed to a 60-inch diameter rotating stainless steel

collar screen having 14 square feet of available screen area and a 165 mesh. The screen is backwashed at the rate of 0.235 gallons of backwash water per 1000 gallons of applied sewage. The unit is capable of 99% removal of floatable and settleable solids, 34% removal of total suspended solids, and 27% removal of COD. The screened effluent is typically 92% of the influent flow. The estimated cost of treatment is 22¢/1,000 gal on the basis of a scale-up design.

046
CHARACTERIZATION AND TREATMENT OF COMBINED SEWER OVERFLOWS,
Engineering-Science, Inc., Arcadia, California

City and County of San Francisco, Calif, Nov 1967. 202 p, 59 fig, 24 tab, 21 ref. FWPA Grant WPD-112-01-66.

Descriptors: *Pollution abatement, *Discharge, *Overflow, *Water pollution, *Sewage effluents, Flotation, Chlorination, Aeration, Sewerage.
Identifiers: *Combined sewers, San Francisco, California, San Francisco Bay.

This publication is the final report of a study made by the City and County of San Francisco to develop workable systems to manage overflows from the combined sewers of San Francisco. The ultimate objective is to alleviate pollution of the Bay and the Pacific Ocean caused by sewer overflows. The Selby Street sewer system and the Laguna Street system were used as study sites. Storm overflows were monitored for quantity and quality characteristics. Rain gage measurements were also recorded. A coliform survey of the municipal marina was made, and laboratory tests were conducted to select suitable methods for treating combined sewer overflows. The project findings were: 1) concentrations of various constituents in the overflows follow a distinct pattern; 2) the delay time is constant; 3) separation in sewers would not result in any significant reduction in the pollution of receiving waters; 4) coliform levels in receiving waters are significantly affected by wet weather discharges; and, 5) treatment of the combined sewer overflows, using the dissolved air flotation process in conjunction with chlorination, appears to be the most feasible solution.

047
PROPOSED COMBINED SEWER CONTROL BY ELECTRODE POTENTIAL,
Merrimack College, North Andover, Massachusetts

FWQA , Program No 11024DOK, Feb 1970.
69 p, 20 fig, 10 tab, 38 ref.

Descriptors: *Pollution abatement, *Laboratory tests, *Measurement, *Sewage disposal, *Investigations, *Overflow.
Identifiers: *Discharge modulation, *Electrode potential.

The objective of the report was to investigate the effectiveness of electrode potential measurements to modulate discharge from combined and storm sewer overflows thus reducing stream and estuarine pollution. The analysis of experimental results, using predominantly stale, domestic sewage in the laboratory, shows a high degree of correlation between the electrode potential of the sewage and its strength. The 3/8-inch diameter Ag, AgCl-Pt flow through cells, showing no polarization during the ten months of sewage experimentation, were found to yield the most stable, reproducible, and accurate readings. Based on these limited investigations it appears that the addition of a buffer to sewage may be helpful in stabilizing the potential, although the influence of a strong reductant may be masked. It was demonstrated that the potential will be more negative the greater the S= concentration, except when a small amount of DO is present which exerts an attenuating influence.

048
DISPATCHING SYSTEM FOR CONTROL OF COMBINED SEWER LOSSES,

James J. Anderson
An Interim Report to the Federal Water Pollution Control Administration, Minneapolis, Minn, May 1969. 115 p, 76 fig, 20 tab.

Descriptors: *Flow control, *Control systems, *Pollution abatement, *Remote control, Surface runoff, Sewers, Urbanization, Monitoring, Minnesota.
Identifiers: *Combined sewers, *Overflow regulators.

The report describes a $1,741,000 demonstration project initiated as part of a national program designed to find alternatives to the costly method of sewer separation for reducing pollution of receiving waters from overflows of combined sewers. Key combined sewer regulators in the Minneapolis-St. Paul sewer system were modified. A system for remote control of these regulators and a system for monitoring liquid levels in major sewers are operational, using a small process control computer and leased telephone lines. Remote reading rain gages were connected to the system to permit using a mathematical model in the computer to predict storm flows in the interceptors and to guide operation of the regulators. Significant reduction of pollution in the Mississippi River from overflows are attributed to: manual-remote monitoring of sewer levels, regulator modifications, and improved regulator maintenance. The program has demonstrated that overflow regulators can be remotely controlled using a computer-based telemetry system.

049
A RE-EXAMINATION OF THE STORM TANK PROBLEM,

L. B. Escritt
Water Waste Treat J, Vol 12, pp 298-300, 1969.

Descriptors: *Storage, *Treatment, Storms, Sewerage.
Identifiers: *Storm sewage, *Storm tanks, Combined sewers.

The author discusses current practices and recommendations concerning the storage and treatment of storm sewage from combined or partially separated sewerage systems, and suggests that tanks of large capacity should be installed to provide adequate storage for all storm periods. Spillage volumes from storm sewage tanks of various detention periods are tabulated for storms of various durations assuming full treatment of 6 times the dry-weather flow and an average impermeable area for a combined sewerage system.

050
STORM-WATER RETENTION CAN WORK...and Prevent the Heavily Polluted "First Flush" from Overflowing to Damage the Receiving River,

Gerald Remus
Am City, Vol 85, No 10, pp 68-69, Oct 1970. 2 fig.

Descriptors: *Storm runoff, *Sewers, *Monitoring, *Control systems, Sewerage, Data collections.
Identifiers: *Detroit, Michigan, *Overflow abatement.

An intense thunderstorm over Detroit, Michigan dropped about one billion gallons of water with about 450 million gallons entering the sewer system that processed 365 million gallons in excess of average flow during the following 30 hours. The system retained so much storm water that the overflow outfalls, which normally discharge into the Detroit and Route Rivers, had very little to do. The sewer monitoring and remote control system, briefly discussed, efficiently compiled rainfall and sewer-level data every five minutes.

051
CAN POLYMERS HELP YOUR COLLECTION SYSTEMS?,

I. W. Santry
Water Wastes Eng, Vol 7, No 11, pp 47-48, Oct 1970. 2 fig, 1 ref.

Descriptors: *Overflow, Sewers, Flow rate, Peak loads.
Identifiers: *Polymers, Capacity.

The use of polymers, formed by chain grouping of similar organic molecules being cationic, anionic, or nonionic, reduce fluid flow friction resulting in an increased velocity in a sewer during application for varying distances downstream. What happens in the system is that the long chains of high molecular organic material dampen the eddy viscosity conditions making greater use of streamlining and the extension of the laminar boundary layer into the turbulent flow region. At present polymers appear to be limited to short time uses that occur because of peak flows and other emergencies.

052
STORM WATER/SEWAGE CONTROL,

Walter J. Talley
Effluent Water Treat J, Vol 10, No 10, pp 592-595, Oct 1970.
3 fig, 4 ref.

Descriptors: *Screens, Equipment.
Identifiers: *Combined sewers, *Storm overflows, *Wastewater concentrator.

The combined sewer overflow problems affect approximately 36 million people in England and Wales, and 51 million people in the United States. Over a year's period, estimates on the percent of liquid sanitary sewage that overflows with the storm overflow in combined sewer systems vary from 2% to 10%. High-rate, fine-mesh screens and the wastewater concentrator, which are the products of research basically directed at finding means for storage and treatment of storm/sanitary overflows, are discussed briefly.

SECTION 3.

Sewer Hydraulics

053
EFFECT OF RAIN COLLECTING BASINS ON THE YEARLY INFLUX OF POLLUTANTS INTO A SEWER MAIN: FUNDAMENTALS OF DIMENSIONING COLLECTING BASINS,

Walter Munz
Gas-Wasserfach, Vol 109, No 30, pp 823-827, Jul 26, 1968.
4 fig, 1 tab, 8 ref.

Descriptors: *Sewers, *Infiltration, *Water pollution sources, Mathematical studies.
Identifiers: *Collecting basins.

The International Water Protection Commission for Lake Constance was faced with the question of the magnitude of the effect of an individual measure on the yearly influx of pollutants into the sewer main. To provide an answer, the author worked out a procedure for computations of material flows for different combinations of measures of differing effectiveness under given conditions. Such computations were carried out at the Zurich Technical University and the Baden-Wurttemberg Hydrological Administration. The results of the computations relating to the elimination of BOD by various combinations of pertinent measures are presented in graphs and briefly discussed. The author also presents a systematic classification of all possible kinds of rain collecting basins according to basin type and the relative altitude of the basin outlet with respect to its inlet.

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SECTION 4.

Sewer Systems

4a. Combined

054
THE CARDIFF EASTERN DISTRICT DRAINAGE SCHEME,

S. R. Salt
Inst Munic Engrs, London, Vol 97, No 9, pp 246-254, Sep 1970.
8 fig, 2 ref.

Descriptors: *Sewerage, *Sewers, *Planning, *Drainage systems, Treatment facilities.
Identifiers: *Great Britain.

The area around Cardiff, Wales is serviced by three sewerage systems which have continued in use from the latter half of the 19th century until recently, with only one major change, despite expansion of the city. It was clear that a major renewal was required if further development on the east side of the city was not curtailed. The new plans would: 1) eliminate three storm overflows, 2) ensure far off-shore discharge, 3) provide for the screening of the total flow, and 4) maintain existing sewers. Thus the scheme, which is detailed herein, would include two runs of duplication sewers, a new pumping station, and a new sea outfall.

4b. Sanitary

055
ENGINEERING INVESTIGATION OF SEWER OVERFLOW PROBLEM; A Detailed Investigation Into the Cause and Effect of Sanitary Sewer Overflows and Recommended Remedial Measures for Roanoke, Virginia,
Hayes, Seay, Mattern & Mattern Architects - Engineers

FWQA Contract No 14-12-200, Program No 11024DMS, May 1970.
250 p, 10 plate, 101 fig, 60 tab, 31 ref, 8 append.

Descriptors: *Sewers, *Overflow, Infiltration, Storm runoff, Water pollution, Surveys, Computer programs, Flow measurement, Sampling, Construction costs.
Identifiers: *Roanoke, Virginia, *Sanitary sewers.

Three study areas, representing 25% of the area served by the City of Roanoke, Virginia's separate sanitary sewerage system, were used in an analysis of stream pollution resulting from rainfall infiltration and sanitary sewer overflows. Data from rainfall gauges were correlated with historical rainfall data to establish precipitation frequencies. Flows in the sanitary sewers and streams were gauged during storm events to measure infiltration and runoff quantities and to establish their relation to rainfall intensities and durations. Samples were obtained during storm events to assess the quality of sewer overflows and storm runoff. A computer program was developed to permit the analysis of the sewerage system under various rainfall frequencies and durations, to calculate the overflow quantities discharged to the watercourses, and to assess the sewer overflow problem for the entire urban area. Rates of infiltration in the sanitary sewers were found to be as high as 24,000 gallons per inch of pipe diameter per mile per day which produced overflows from a single event equivalent to 14% of the daily untreated sewage. Various remedial measures were investigated and a program, based primarily on reducing infiltration by at least 80%, was presented. The cost would be about $61 per capita.

4c. Storm

THERE ARE NO ABSTRACTS FOR THIS SUB-SECTION OF THE SECOND QUARTERLY ISSUE DUE TO A LACK OF INFORMATION PERTINENT TO THIS CATEGORY.

SECTION 5.

Storm water - Quality, Quantity, and Pollution

5a. Caused from combined overflows

056
POLLUTION FROM COMBINED SEWERS; CINCINNATI, OHIO,

Arthur D. Caster and William J. Stein
Am Soc Civil Engrs Meeting, Preprint No 1090, 1970. 39 p, 13 fig, 5 tab.

Descriptors: *Sewage, *Storm runoff, *Waste treatment, Treatment facilities.
Identifiers: *Combined sewer overflow, *Cincinnati, Ohio.

The sampling and gaging program was designed to provide basic data to estimate the magnitude of combined sewage pollution in and from the Mill Creek Basin, and by extrapolation, the Cincinnati Service Area. The description of the Service Area, the background hydrological and water quality data, the field investigation program, the analysis of the data, and conclusions are presented herein.

057
ASSESSING THE QUALITY OF URBAN DRAINAGE,

W. Viessman
Public Works, Vol 100, No 10, pp 89-92.

Descriptors: *Water quality, Model studies, Cities.
Identifiers: *Storm sewage, *Urban runoff, Cincinnati, Ohio.

The author reviews literature on the composition of urban storm sewage, including determinations at Cincinnati, Ohio and work on sediment loads, and considers ways of constructing water quality models for runoff from urban areas.

5b. Caused from storm runoff

058
STORM WATER POLLUTION FROM URBAN LAND ACTIVITY; Development of Analytical Procedures for Predicting Storm Water Pollution from Urban Areas by Use of Selectively Defined Urban Characteristics,
Avco Economic Systems Corporation

FWQA Contract No 14-12-187, Program No 11034FKL, Jul 1970.
325 p, 66 fig, 89 tab, 28 ref, 14 append.

Descriptors: *Storm runoff, *Water pollution, *Water pollution sources, *Investigations, *Urbanization, *Pollutants, *Sampling, Cities.
Identifiers: *Tulsa, Oklahoma.

An investigation of the pollution concentrations and loads from storm water runoff in an urban area was conducted in Tulsa, Oklahoma. The scope of the project included: a field assessment of the storm water pollution by obtaining samples of the water resulting from precipitation and surface runoff from selected test areas within the metropolitan area; development of an analytical procedure for correlation of storm water pollution with selectively defined variables of land uses, environmental conditions, drainage characteristics, and precipitation; and development of a plan for implementing remedial measures necessary to abate or control sources of pollution in an urban area. Runoff samples were analyzed in terms of quality standards for BOD, COD, TOC, organic kjeldahl nitrogen, soluble orthophosphate, chloride, pH, solids, total coliform, fecal coliform, and fecal streptococcus pollutants. Selected land use parameters, environmental conditions, drainage and precipitation data, along with storm water pollution factors, provided input data for functional relationships enabling assessment of pollution from storm water runoff.

059
THE EFFECTS OF URBAN DRAINAGE ON LAKE McILWAINE, RHODESIA,

J. McKendrick and R. K. Williams
Water Pollution Control, Vol 68, pp 523-528, 1969.

Descriptors: *Water quality, Water treatment, Effluents, Investigations, Water pollution sources.
Identifiers: *Rhodesia, *Urban runoff, Algal growth.

From 1953 to 1959 there was little change in the quality of the water in lake McIlwaine, which is the main source of supply for Salisbury, Rhodesia, but from 1960 trouble began to be experienced with heavy algal growths which interfered with treatment of the water. When the lake water intake level was lowered to avoid the algae, problems were caused by manganese and iron in the lower waters of the lake. Studies on conditions in the lake showed that the algal growths were caused by high concentrations of phosphate and nitrogen brought into the lake by the rivers to which the effluents from the city's sewage works and oxidation lagoons were discharged; algal growths were most severe during periods of low rainfall when less dilution was available.

060
DETERMINATION OF THE POLLUTIONAL EFFECT OF SURFACE RUNOFF,

N. A. Pravoshinsky and P. D. Gatillo
In: Advances in Water Pollution Research, Proceedings 4th International Conference on Water Pollution Research, Prague, Czechoslovakia, Apr 21-25, 1969, Pergammon Press, Ltd, pp 187-195, 1969. 3 fig, 1 tab, 27 ref.

Descriptors: *Water pollution sources, *Cities, *Storm runoff, *Surface runoff, *Urbanization, Water pollution effects, Foreign research.
Identifiers: *USSR.

Pollution by urban surface runoff depends on the intensity of movement of street traffic and use by pedestrians, type of cover of catchment, duration and intensity of rain, standards of water discharge of watering and washing, the amount of dust deposition, the elevation of the catchment water basin, duration of preceeding dry weather period, quality and technology of town cleaning, and the means of dust control. Data were compiled from samples collected in the well-built-up districts of Minsk, USSR, remote from big industrial enterprises and Soligorsk, a rapidly developing town. The value of 5-day BOD was used as a primary index of runoff pollution. In addition the concentrations of suspended solids, chlorides, oil-products, and bacterial pollution were determined.

061
URBAN DRAINAGE AS A FACTOR IN EUTRCPHICATION,

S. R. Weibel
Paper presented at the International Symposium on Eutrophication, Madison, Wisconsin, Jun 11-15, 1969. 20 p, 2 fig, 9 tab, 31 ref.

Descriptors: *Sewage, *Storm runoff, *Water pollution sources, *Urbanization, *Nutrients, *Overflow.
Identifiers: *Combined sewers, *Urban drainage.

In this article the topic of urban drainage includes sewage as well as storm water runoff and combined sewer overflows. Since current research activities on the control of nutrients in connection with sewage treatment seem well documented, this paper is devoted to storm water runoff and combined sewer overflows as sources of water pollution, including nutrient contributions, an area of study where much work is needed. The urbanization explosion means that more people, more demands for water for all purposes, more wastes, more storm water runoff--all are impressed upon existing time, space, facilities, and habits already representing huge investments.

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SECTION 6.

Surveys, Policies, and Reports

062
METROPOLITAN BOSTON'S WASTEWATER QUALITY CONTROL PROGRAM,

Water Sewage Works, Vol 117, No 9, pp 300-304, Sep 1970.

Descriptors: *Water pollution sources, *Overflow, *Legislation, *Treatment facilities, Pollution abatement, Water quality control.
Identifiers: *Storm overflows, *Boston, Massachusetts.

This paper traces the historical factors contributing to the sewage problems in Boston, Massachusetts and accredits the general causes for the pollution conditions to: 1) the raw sewage discharge into Boston Harbor, and 2) mixed sewage and storm water overflow into tributary rivers, streams, and basins. Pertinent sections of legislation authorizing pollution control construction as well as associated legislative acts are mentioned. A description of existing sewage treatment plants and important features of the improvement programs is given. A new anti-pollution installation on the Charles River, expected to be undergoing acceptance and evaluation tests in late 1970, will accumulate, detain, and chlorinate overflow from combined sewage and surface drainage occurring during heavy storms.

063
COMBINED SEWER REGULATOR OVERFLOW FACILITIES; Report,
American Public Works Association

FWQA Contract No 14-12-456, Program No 11022DMU, Jul 1970.
139 p, 38 fig, 29 tab, 4 append.

Descriptors: *Overflow, *Regulation, Design, Operations, Maintenance, Control systems.
Identifiers: *Combined sewers, Tide gates, Overflow quantity, Overflow quality.

Current design, operation, and maintenance practices used by local jurisdictions in the United States and Canada were determined by personal interviews and compiled in this report. Particular attention was given to the performance of various types of regulators, the use of tide gates, new designs, European practices, and the systems concept of combined sewer regulation. Thirty-seven drawings and photographs of regulators are included. 17 recommendations are made, the adoption of which would upgrade regulator facilities and tend to reduce receiving water pollution from combined sewer overflows.

064
COMBINED SEWER REGULATION AND MANAGEMENT; A Manual of Practice,
American Public Works Association

FWQA Contract No 14-12-456, Program No 11022DMU, Jul 1970.
134 p, 41 fig, 1 tab.

Descriptors: *Overflow, *Regulation, Design, Operations, Maintenance, Control systems.
Identifiers: *Combined sewers, Tide gates, Overflow quantity, Overflow quality.

Design application, operation, and maintenance of combined sewer overflow regulator facilities are detailed in this Manual of Practice, developed in conjunction with a report prepared on combined sewer overflow regulators. Design calculations are given for various types of regulators and tide gates. A sample regulator facility control program is given to illustrate the development of a control system. Operation and maintenance guidelines are also given. Thirty-eight sketches and photographs are included.

065
AREAWIDE WATER AND SEWER PLAN, COMPREHENSIVE PLANNING STUDY, HARRISON, ARKANSAS,
Harrison City Planning Commission, Arkansas

Jun 1970. 27 p.

Descriptors: *Sewers, *Urbanization, *Project planning, Water supply, Sewage treatment.
Identifiers: *Storm sewers, Harrison, Arkansas.

This water and sewer study is based on earlier volumes of a comprehensive plan concerning public utility improvement projects in a specific planning area.

066
REPORT TO THE CITY OF FLINT, MICHIGAN ON SANITARY AND STORM SEWER SYSTEMS,
Metcalf and Eddy, Inc., Boston, Massachusetts

Report to Department of Public Works and Utilities, City of Flint, Michigan, Sep 12, 1969. 159 p, 11 fig, 12 tab, 11 ref.

Descriptors: *Sanitary engineering, *Sewers, *Sewerage, *Infiltration, *Drainage systems, *Urbanization, *Pollution abatement, *Storm runoff, *Water pollution control, Separation techniques, Sewage treatment, Treatment facilities, Future planning.
Identifiers: *Combined sewers, *Sanitary sewers, *Storm sewers, *Flint, Michigan.

The report describes the study procedures and presents the findings, conclusions, and recommendations of an engineering investigation of the adequacy of the sanitary sewer and storm sewer systems and the wastewater disposal facilities of the City of Flint. The sewer systems performed their present functions satisfactorily; however, major problems were: 1) basement flooding, 2) river pollution, and 3) potential flooding from future storm water discharges from adjoining townships. In addition to recommendations for system improvements and expansion of existing facilities, several far-reaching and unconventional recommendations were made. Special field investigations of surface and groundwater infiltration into existing sewers are also recommended. The need for cooperation between Flint and Genessee County is stressed, particularly for rainfall and runoff data collection and flood plain conservation.

067
STORM WATER POLLUTION, NEW ORLEANS, LOUISIANA,
New Orleans Sewerage and Water Board, Louisiana

Supplementary Report, Jun 1970. 56 p, 52 fig. Repair work in conjunction with Community Renewal Program Project No La-R-6 (CR).

Descriptors: *Repairing, *Sewers, *Leakage, *Water pollution control, *Pollution abatement, *Drainage systems, *Storm drains, *Municipal wastes, *Sewerage, *Water quality control, Waste water treatment, Path of pollutants.
Identifiers: *Sewer repairs, *Storm water pollution, *Sewer inspection, *Sewer leakage, *New Orleans, Louisiana, Televised inspection.

The results were evaluated of sewer repairs that were made by the New Orleans Sewerage and Water Board to correct major leaks and defects found using television equipment. Field inspection work was conducted in 1969 to determine how and to what extent the storm waters discharged to Lake Pontchartrain are being polluted by domestic sewage. The results were published in a basic report having the same title as this supplementary report. Upon completion of the repairs of 47 major defects, exfiltration tests were made on the repaired lines. The results indicated excessive leakage still existing. Television photographs of pipe leakage and exfiltration data are included.

068
STORM WATER POLLUTION, NEW ORLEANS, LOUISIANA
New Orleans Sewerage and Water Board, Louisiana

Final Report, Jun 1970. 117 p, 19 fig, 49 tab, 14 ref. Community Renewal Extension Project No La-R-6 (CR).

Descriptors: *Pollutant identification, *Water pollution, *Path of pollutants, *Water pollution control, *Pollution abatement, *Storm drains, *Drainage systems, *Sewers, *Municipal wastes,

*Sewerage, *Water quality control, Repairing, Design standards, Installation.
Identifiers: *Storm water pollution, *Sewer leakage, *Televised inspection, *Sewer inspection, *New Orleans, Louisiana.

The findings are presented of field inspections of the operating condition of sanitary sewers and storm sewers in New Orleans to determine how, and to what extent, the storm waters discharged to Lake Pontchartrain are being polluted by domestic sewage. Television cameras were pulled through sewers to view leakage into sewer pipes at open joints, fractures, and house connections. It was found that the major source of storm water pollution came from accidental cross flows between sanitary sewer house connections and storm sewers at points of crossings, particularly where house sewers cross beneath storm sewers. The fractures are attributed to the weight of the overlying storm sewer on the house connections beneath. Recommendations are given for the design and installation of sanitary sewers, house connections, and storm sewers. Explanation of field inspection procedures and television inspection data are included.

069
FINAL REPORT OF THE TECHNICAL COMMITTEE ON STORM OVERFLOWS AND THE DISPOSAL OF STORM SEWAGE,

J. T. Calvert
Inst Civil Engrs (London), Vol 47, pp 305-308, Oct 1970.

Descriptors: *Sewage disposal, Costs, Water pollution sources, Sewers.
Identifiers: *Storm overflows, Great Britain.

An informal discussion on the Committee's findings shows that: 1) the abolition of all storm overflows was not recommended because the enormous cost could not be justified and pollution from surface water sewers could still occur; and 2) a new formula, in which the amount of sewage to be contained in the system downstream of the overflow would vary only slightly with water consumption and the formula would broadly ensure that the polluting matter from each person was diluted by a fixed amount of rainwater before spill commenced, were recommended.

070
THE OPTIMIZATION OF STORM-HOLDING TANKS: A PROBLEM OF WATER POLLUTION CONTROL,

Charles Albert Kohlhaas
Dissertation, Feb 1970. 321 p.

Descriptors: *Optimization, *Storm drains, *Economics, Mathematical models, Chlorination, Infiltration.
Identifiers: *Storm sewage, *Combined sewers, Effluent tax, San Francisco Bay.

A literature review of the hydrology, quality, effect on the environment, and control technology of combined sewer overflows and overflows from sewers subject to heavy infiltration is made. An analysis of water pollution externalities and remedies for dealing with them, including the use of effluent tax in particular, is given. The relationship between the pollution caused by storm-sewage overflow and competing urban needs is investigated. Two mathematical programs for optimizing control facilities from storm-sewage overflows are defined: one achieves economic efficiency by means of the effluent tax, the other incorporates water quality goals by means of stream standards. The stream standards program is applied to a practical problem of storm-sewage overflow in East San Francisco Bay, California. Water quality regulations for controlling overflows are formulated and treatment processes based on the use of holding tanks are defined. The effect of a holding tank on input discharge, BOD, and coliform concentrations is described. Graphs relating BOD load and average coliform concentration of holding tank effluent to tank capacity are employed to size holding tanks capable of meeting effluent standards. The mathematical program is solved as a separate non-linear program. Detention times needed to satisfy BOD limitations were more than adequate to meet limitations on coliform concentrations. For most cities the high cost of solutions to storm-sewage overflow problems will prevent the implementation of control measures in the near future. An effluent tax may be used as a means of financing alternative recreation and as an incentive for implementation of control measures. Requirements concerning maximum coliform concentrations are best met by limitations on the minimum size of holding tanks. Optimization models capable of incorporating an almost infinite number of holding tanks and over 2,000 water quality requirements may be constructed.

071
CITY OF PERU V CITY OF LA SALLE (RIGHT TO HAVE SURFACE WATERS NATURALLY DISCHARGED),

255 NE2d 502-507 (Ill Ct App 1970)

Descriptors: *Illinois, *Cities, *Drainage water, *Storm drains, Storm runoff, Water rights, Surface runoff, Legal aspects, Drainage systems, Sewers, Outlets, Natural steams.

Plaintiff City of Peru sought an injunction to restrain defendant City of La Salle from draining water through a storm drain from the city limits of La Salle into a ravine which ultimately drained onto property belonging to plaintiff. Plaintiff contended that in the absence of a natural watercourse draining the dominant land onto the serient land, defendant had no right to drain its land through the tile system onto plaintiff's land. Plaintiff also claimed a prescriptive right to be free from the drainage water since defendant's sewer system had drained water away from Peru for the past twenty years. The court denied the injunction stating that even in the absence of a natural watercourse, surface water may be drained into the same point of discharge where it would normally have found its way and the servient landowner cannot complain. The court also held that any prescriptive right that plaintiff asserted would be limited to the amount of water actually diverted by defendant and would not involve other surface water. Plaintiff failed to establish any such amount.

072
METHODOLOGY IN ESTABLISHING WATER-QUALITY STANDARDS,

Robert O. Sylvester and Carl A. Rambow
Water Resources Management and Public Policy, University of Washington Press, pp 110-122, 1968. 2 tab, 3 ref.

Descriptors: *Water quality, *Standards, *Washington, *Methodology, *Water quality control.

The methodology for establishing water quality criteria as presented here was done for the state of Washington where most waters do not suffer from damaging pollution. Some aspects of the methodology may be more difficult to apply to regions where most waters are more severely damaged by pollution. A comparison of the goal and standard values, with present water quality and minimum recorded water quality in forty principal stream reaches in the state of Washington gave the following results for nine parameters: in the case of present quality about 92% exceeded goal values, 6% lay between goal and standard values and about 2% fell below standard values; in the case of minimum recorded water quality, about 73% fell above goal values, 11 between goal and standard values, and 16% below standard values.

SECTION 8.

Treatment Methods and Reuse

073
INDUSTRIAL RE-USE OF COMBINED SEWAGE-TREATMENT PLANT EFFLUENT,

E. R. Hamilton and C. F. Gurnham
International Conference on Water for Peace, Vol 4, 1967 and 1968.
12 p.

Descriptors: *Storm runoff, *Bypasses, *Water pollution sources, *Treatment facilities, Overflow, Sewage disposal, Water reuse.
Identifiers: *Storm sewage, *Chicago, Illinois, *Treatment method.

After reviewing the increasing water demands of the United States and the problems of future water shortage, the authors describe the steps taken at East Chicago, Illinois, to overcome problems of pollution and water shortage. Excess storm sewage which bypasses the sewage works enters Grand Calumet river and thence the southern part of Lake Michigan, causing serious restriction on the use of water for recreational purposes, particularly swimming. It is financially impossible to replace the combined sewerage system by a separate system; also, storm runoff is highly polluting. A scheme was therefore developed which will receive effluent from the existing sewage works and overflows of storm sewage from about one-third of the city, providing treatment by equalization, sedimentation, oxidation, and biological processes. In dry weather there will be a detention period of at least 10 days; and at peak storm periods there will be a minimal detention period of 24 hours. Discharge from the detention basins will be chlorinated and held in the overflow channel for the customary disinfection period of 15 minutes before entering the Grand Calumet river. It is proposed that flows up to 20 mgd will pass from the detention basin to a new tertiary treatment plant, on which pilot-scale studies are being made. The quality of the effluent will not only meet the anticipated standards for discharge to the Grand Calumet river, but will approach requirements for potable use and will be acceptable for use as cooling water and often as industrial process water. The plant will be flexible in operation, and water of almost any desired quality could be tapped off at various points for sale to industry.

074
TERTIARY TREATMENT OF SEWERAGE WATER,

Shozo Miyahara and Tokiya Ando
Sangyo Kogai, Vol 6, No 8, pp 454-461, Aug 25, 1970. 46 ref.

Descriptors: *Tertiary treatment, *Water purification, *Water resources, *Feasibility.
Identifiers: *Sewerage water, *Japan.

Because of the increasing water need, the feasibility of sewerage water reuse is being investigated both technically and chemically. This new advanced method of utilization, tertiary treatment, is aimed at higher level purification of sewerage water beyond the secondary treatment stage. Due to projected water demand sewerage water has a great potential as a new water resource if advanced technology is employed. Some problems involved in sewerage water reuse are associated with water quality including: generation of corrosion, slime scale and ABC foaming, higher seasonal temperatures, and chloride ion concentration. Sewerage water reuse is presently limited in its application to cooling and washing uses. Discussed herein are several types of tertiary treatment for sewerage water primarily involving removal of suspended solids, nitric or phosphoric compounds, organic substances, and chlorine contained in sewerage water after secondary treatment.

075
PLANNING OF MUNICIPAL WASTEWATER RENOVATION PROJECTS,

J. W. Porter
J Am Water Works Assoc, Vol 62, No 9, pp 543-548, Sep 1970.
3 fig, 2 tab, 6 ref.

Descriptors: *Water reuse, *Economics, *Cost comparisons, *Project planning, Water pollution control.

Increasing interest in water renovation and reuse rather than simply waste treatment and discharge is due to the severity of pollution control laws and localized shortages of water resources. Economic considerations concern cost comparisons between the water pollution control/water supply functions of a water renovation facility, and the same functions in separate facilities. Technical considerations in planning a water renovation project are largely a function of the planned use of the product water. Several technical aspects are discussed including: process selection and water quality criteria, renovation system reliability, public health considerations, and pilot - demonstration work. The functions of water pollution control and water supply should be recognized institutionally, which involves cooperation between parties concerned. Five guidelines are included as suggestions in planning for public acceptance of water renovation.

SECTION 9.

Hydrology

076
A RECURSIVE PROGRAMING MODEL FOR NONSTRUCTURAL FLOOD DAMAGE CONTROL,

John C. Day
Water Resources Res, Vol 6, No 5, pp 1262-1271, Oct 1970. 17 ref.

Descriptors: *Flood plains, *Flood damage, *Flood control, *Land use, *Urbanization, *Storm runoff, Land management, Economics, Design criteria, Computer programs, Model studies.

This paper deals with flood plain land use management approaches for urban flood damage control. These alternatives are important because traditional flood control projects, such as levees, channel improvements, and reservoirs, are not always capable of correcting the physical and economic conditions that give rise to flood damage. It is expected that land use management will complement engineering works and lead to a more effective use and development of flood plain lands. The paper presents a computational technique for evaluating alternative land use assignments based upon the economic value a community gains from its land. A linear programming model is developed that identifies economically efficient combinations of 1) spatial and temporal planning of urban land use, 2) site elevation through landfill, and, 3) flood proofing of buildings.

077
PROBABILITIES FOR SIMULTANEOUS OCCURRENCE OF FLOODS IN THE DANUBE AND INN RIVERS BEFORE AND AFTER COMPLETION OF STRUCTURES IN THE DANUBE RIVER,

Gert A. Schultz
Wasserwirtschaft, Vol 9, pp 293-296, 1970. 9 fig, 1 tab, 6 ref.

Descriptors: *Floods, *Flooding, *Flood forecasting, Synthetic hydrology, Hydraulic structures.
Identifiers: *Danube River, *Inn River.

The flood statistics for the city of Passau reveal that whenever one of these two rivers carried a flood wave the other produces a flood several days after. The Danube peak usually follows the Inn peak. Based on 67 independent flood events between 1926 and 1967, the probability for the "critical case" (the simultaneous occurence of flood peaks of the Danube and Inn Rivers' confluence) has been investigated and reported herein. An attempt has been made to estimate the influence of hydraulic structures in the Danube river upstream of the confluence on the "critical case" probability. If this influence can be determined then it is possible to investigate the future tendency of a synthetic flood frequency analysis for the Danube river downstream of the confluence.

078
PRELIMINARY ANALYSIS OF RATE OF MOVEMENT OF STORM RUNOFF THROUGH THE ZONE OF AERATION BENEATH A RECHARGE BASIN ON LONG ISLAND, NEW YORK,

G. E. Seaburn
In: Geological Survey Research 1970, Chapter B, pp B196-B198, 1970. 3 fig, 1 tab, 2 ref.

Descriptors: *Infiltration, *Artificial recharge, Groundwater movement, Storm runoff, Urbanization, Cities.
Identifiers: *Long Island, New York.

A study of recharge basins on Long Island has provided information on the rate of movement of water through the zone of aeration. Pertinent data were collected during 38 storms from a basin in Central Nassau County, where the depth to the water table is 35 ft below the bottom of the basin. In this basin the apparent downward rate of movement averaged 5 feet per hour; it ranged from an average of 3 feet per hour for storms in November through March to an average of 6 feet per hour for storms in April through October.

079
URBANIZATION AND THE WATER BALANCE,

Andrew M. Spieker
In: Proceedings of Symposium on Water Balance in North America, Jun 23-26, 1969, Alberta, Canada, American Water Resources Assoc, Urbana, Illinois, pp 182-187, 1969. 2 fig, 8 ref.

Descriptors: *Urbanization, *Rainfall-runoff relationships, *Water pollution sources, Cities, Time lag, Sediment load, Waste disposal, Floods, Hydrographs, Peak discharge.
Identifiers: Urban hydrology, North America.

Urbanization modifies the hydrologic balance by causing changes in the distribution and quality of water in time and place. The overall quantity of water, however, remains essentially unchanged. In extreme cases, the lack of adequate management measures can result in catastrophic events. Several examples are cited. In 1969 floods in southern California were intensified by uncontrolled urban sprawl in alluvial fans and canyons. Sewering of urbanized areas on Long Island has caused an increase in direct runoff and flood peaks, and a lowering of groundwater levels. Detailed studies of storm runoff in Fairfax County, Virginia, have shown that urbanization in small watersheds increases peak flow by 2 to 3 times, and shortens the lag time by about 8 times. Intensive construction in urbanizing areas can result in sharply increased sediment loads in streams and lakes. Chemical and bacterial quality of water are also affected by urbanization. Studies of Salt Creek, a small stream in suburban Chicago, indicate high coliform and BOD levels at both low and high flows. Coliform counts are greater at high flows, resulting from combined sewer overflows.

080
MEAN ANNUAL RAINFALL/RUN-OFF RELATIONSHIP,

L. H. Young
J Ind Water Engrs, Vol 24, No 7, pp 423-430, Oct 1970. 1 fig, 3 tab.

Descriptors: *Rainfall-runoff relationships, *Cities, Analysis, Water loss.
Identifiers: *Urban hydrology.

World wide data are analyzed to investigate the relationship between the mean annual runoff, rainfall, and temperature of cities. Other parameters considered are found to have little independent effect. For non-arid climates the relationship is a striaght line for which the slope is unity for 50 degrees F, steeper for lower temperatures, and flatter for higher temperatures. Water loss is found to be independent of rainfall only in the region of 50 degree F. A general runoff formula is developed for the overseas data, and a separate formula for the British Isles.

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SECTION 10.

Tunnels: Technology and Equipment

081
CUSTOM DESIGNED SHIELD LEAVES NO SPACE BEHIND AS IT SETS TUNNEL RINGS,

Construct Methods Equip, Vol 52, No 8, pp 64-67, 70, 72, Aug 1970.

Descriptors: *Drilling, *Tunnel construction, *Tunneling machines, Tunnel design.
Identifiers: *Tunneling shield, *Mexico.

A tunneling shield used to drive a 30-ft diameter bore at shallow depths in soft, unstable ground, was designed to progress through drive cycles without leaving an annular space behind the shield after the shove had been made. The tunnel was driven up a constant incline having profile variations of from 0.8 to 7% at depths ranging from 52½ feet to 16 feet below street level. Guidance made use of a laser and target system; excavation was performed by a dozen miners working from the shield's six breasting tables with pneumatic spades and rock breakers. A description of the tunneling cycle is given.

082
RESEARCH AND DEVELOPMENT RELATED TO TUNNELING,
Organization for Economic Co-Operation and Development, Paris, France

In: Advisory Conference on Tunneling of the Organization for Economic Co-Operation and Development, Aug 1970. 108 p.

Descriptors: *Tunneling, *Research and development, Construction, Underground structures.
Identifiers: Questionnaire.

The document is concerned with the status of applied research and development relating to tunneling technology. Applied research and development means theoretical and experimental studies of new design methods and construction techniques, including studies of the properties, character and behavior of tunnel structures, and of the ground mass in which they are constructed.

083
BOSTON STILL FACES A POLLUTION CONTROL PROBLEM; Deep Tunnel Plan Proposed as Solution,

Joseph Cazzaza
Water Wastes Eng, Vol 7, No 9, pp 44-47, Sep 1970.

Descriptors: *Water pollution control, *Pollution abatement, Sewers, Sewerage, Treatment facilities.
Identifiers: *Deep tunnel plan, *Boston, Massachusetts.

In this article the related development of combined sewerage systems in the Boston metropolitan area is traced and some of the major attempts to abate pollution in the harbor and its estuaries are discussed. Presently, the sewage from the area south of the old Boston Main Drainage District is treated at the Nut Island plant, while most of the sewage from the remaining Metropolitan Sewerage District is treated at the Deer Island plant. The two plants provide primary treatment and chlorination for all dry-weather flows from the metropolitan area, yet they cannot handle the enormous quantities of mixed flows during storm conditions. A description of the deep tunnel plan, with an estimated construction cost of $430 million, is included.

084
DESIGN OF TUNNEL SUPPORT SYSTEM,

U. D. Deere, R. B. Pack, and J. Monsees
Paper presented at the 49th Annual Meeting of the Highway Research Board, Jan 1970. 18 p, 1 fig, 4 tab, 10 ref.

Descriptors: *Tunnel design, *Supports, Tunnels, Excavation, Gunite, Economics, Tunnel linings, Rock bolts, Tunneling, Tunnel construction.
Identifiers: *Tunnel supports, Rock breakage.

Selection and design of the support system are two of many interrelated factors in the overall design of a serviceable and economical tunnel. The type of support, method of excavation, and character of the ground are inseparable considerations. Factors pertinent to good design of tunnel supports are: 1) types and functions of tunnel support systems; 2) types of primary support systems; 3) planning and design of tunnel support systems; 4) modern concepts of the design of tunnel support systems; 5) guidelines for selecting primary support systems for rock and soil tunnels; and, 6) improvement in support systems for high-speed tunneling. Results of studies conducted at the University of Illinois on various aspects of design of support systems for tunnels are described.

085
HARD ROCK TUNNELING,

T. E. Howard
In: Advisory Conference on Tunneling of the Organization for Economic Co-Operation and Development, Aug 1970. 74 p.

Descriptors: *Tunneling, *Construction, *Underground structures, Drilling.
Identifiers: *Hard rock tunneling, Technological improvement, Questionnaire.

The report is intended to facilitate the orderly development of tunneling technology by focusing attention on the inadequacies of rock tunneling and the improvements that are needed. The data presented were derived from the results of a comprehensive questionnaire that was completed by individuals and organizations in 17 countries.

086
IMMERSED TUNNEL CONSTRUCTION,

H. C. Wentink
In: Advisory Conference on Tunneling of the Organization for Economic Co-Operation and Development, Aug 1970. 42 p.

Descriptors: *Tunneling, *Construction, *Underground structures.
Identifiers: *Immersed tunnels, Technological improvement, Questionnaire.

The document is concerned with tunnels composed of elements constructed in a dry-dock or on a slipway and subsequently transported to the construction site, where they are sunk, placed on a foundation, and connected together under water. The questionnaire dealing with immersed tunnels brought in replies from twelve countries, many of which were based only on a theoretical knowledge of the subject or on experience with tunnels of very small cross-section.

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JOURNAL LIST

Abbreviation	Full Title
1. Advan Instr	1. Advances in Instrumentation
2. Am City	2. The American City
3. Beton i Zhelezobeton	3. Beton i Zhelezobeton
4. Chem Eng	4. Chemical Engineering
5. Construct Methods Equip	5. Construction Methods and Equipment
6. Effluent Water Treat J	6. Effluent and Water Treatment Journal
7. Filtration Eng	7. Filtration Engineering
8. Gas- Wasserfach	8. Das Gas- und Wasserfach
9. Inst Civil Engrs (London)	9. Institution of Civil Engineers (London)
10. Inst Munic Engrs, London	10. Institution of Municipal Engineers, London
11. J Am Water Works Assoc	11. Journal of the American Water Works Association
12. J Ind Water Engrs	12. Journal of the Industrial Water Engineers
13. Power	13. Power
14. Public Works	14. Public Works
15. Sangyo Kogai	15. Sangyo Kogai
16. Wasserwirtschaft	16. Die Wasserwirtschaft
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18. Water Pollution Control	18. Water Pollution Control
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20. Water Sewage Works	20. Water and Sewage Works
21. Water Wastes Eng	21. Water and Wastes Engineering
22. Water Waste Treat J	22. Water and Waste Treatment Journal

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11020 --- 12/67	Problems of Combined Sewer Facilities and Overflows, 1967, (WP-20-11)
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